other repulsive). One particular feature which is common to all potentials which were able to reproduce large-angle data is that the real part of the central potential is drastically reduced for $0 < r < 2$fm. Associated with this reduction in central attraction is a substantial increase in central absorption. The resulting potentials are illustrated in Fig. 2. This result supports predictions of microscopic theories for the proton-nucleus optical potential.[1,2,3] According to these predictions, the observed reduction of the real potential is typical for the bombarding energy region of this experiment. A more detailed account of this work has been published.[4]

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ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFER AS A TEST OF A MICROSCOPIC POTENTIAL THEORY

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Recently, cross sections and analyzing powers of elastic $^{12}C(\vec{p},p)^{12}C$ scattering at 200 MeV have been measured at IUCF.[1] The data have been analyzed[2] in terms of a microscopically-derived local optical potential. This potential has been derived by phase equivalence from the intrinsically non-local nucleon-nucleus potential using a density-dependent nucleon-nucleon (NN) t-matrix.[3] Figure 1 demonstrates that the agreement of this theory (solid line) with the previously known data (solid dots) is quite respectable in view of the fact that there are no adjustable parameters (also shown in Fig. 1 are phenomenological analyses, discussed in another contribution to this report). The most dramatic feature of the calculation, however, is the predicted rise of the backward cross section. This stimulated the following additional measurements at large scattering angles.

The experiment was carried out with an unpolarized beam and an enriched ^{12}C target (130 mg/cm^2), using the QDDM spectrograph. The usual focal-plane detector array was supplemented by two small-area scintillators positioned along the central ray leaving the QDDM and placed in a 3-fold coincidence in order to reduce the background due to neutron reactions in the detectors. The acceptance of this detector system was sufficient to contain the elastic proton group and allowed the measurement of cross sections as small as 2nb/sr. The data obtained in this manner are displayed in Fig. 1 as open circles.

Clearly, the microscopic model[2] fails the test in a comparison with the new data: the backward cross sections are overestimated by 1-2 orders of magnitude. It has to be pointed out, however, that the new measurements cover an unprecedented range of momentum transfer (4-6 fm^{-1}). It is well possible that the high-momentum components of the NN potential employed (Hamada-Johnston) are not really constrained experimentally and may allow for sufficient adjustment. Theoretical efforts along this line are in progress[4]. Furthermore, it will be necessary to assess the influence of the coupling to the 2^+ (4.4 MeV) state in ^{12}C (which dominates the excitation spectrum at large angles) and to study the uncertainties introduced by the spin-orbit potential which at present is not well understood, as is reflected in the much inferior fits to the analyzing-power data.

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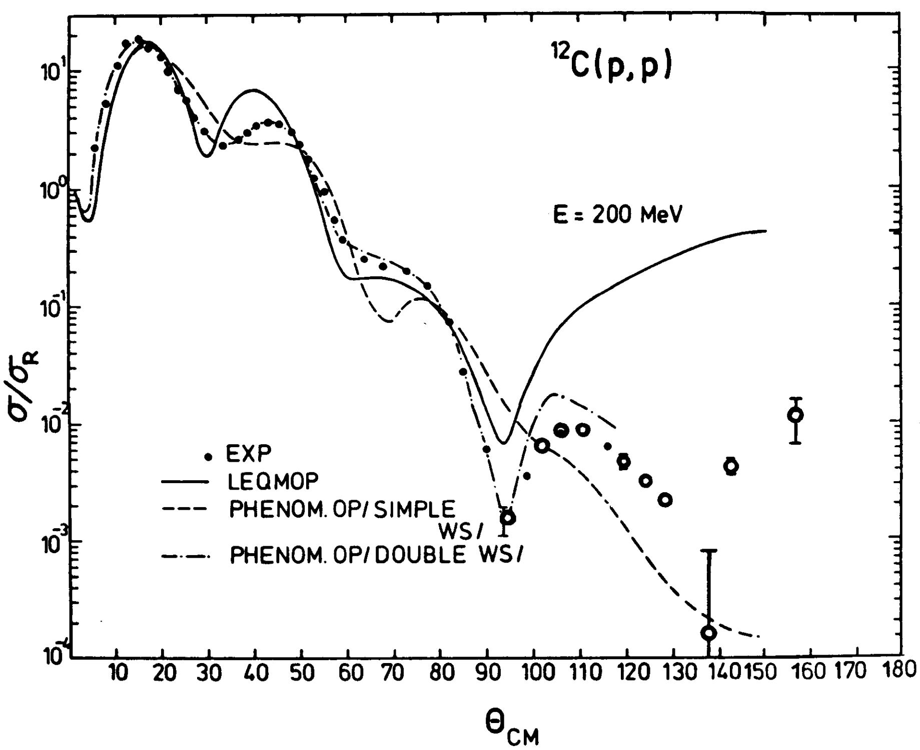

Figure 1. Comparison of the prediction of a microscopically-derived local equivalent optical potential (solid curve) with the measured differential cross sections for 200 MeV p + ^{12}C scattering to high momentum transfer (< 6 fm^{-1}).

ELASTIC SCATTERING OF 200 MeV POLARIZED PROTONS FROM ^{9}Be and ^{16}O

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As part of the program to measure proton elastic scattering from light nuclei (^{9}Be, ^{12,13}C, ^{16}O) at 200 MeV over a wide range of momentum transfer ($q > 5$ fm^{-1}) as input into a systematic study of the real central potential shape in the proton optical model,[1] we have made preliminary measurements of the differential cross section, $\sigma(\theta)$, and analyzing power, $A_y(\theta)$, for $\vec{p}$ + ^{9}Be and $\vec{p}$ + ^{16}O elastic scattering at forward angles, $6° < \theta_{lab} < 52°$, using the QDDM magnetic spectrograph. To obtain the small angle ^{16}O data, a combination of Be and BeO targets was used.

The data obtained so far for $\sigma_{lab}(\theta)$ and $A_y(\theta)$ are presented in Figures 1 and 2, respectively. While the differential cross sections for ^{9}Be and ^{16}O are very similar in structure, major differences in the angular dependence of the measured analyzing powers are